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GEOLOGY.

Lavas and Soils of the Hawaiian Islands.¹—The rocks of the Hawaiian Islands, with the exception of limited accumulations of coral and calcareous sands and a “remarkable felspathic andesite” reported by Dana, are basaltic lavas. The surface lavas have been changed to soil by two processes: first, by the action of heated vapors charged with sulphuric acid; and, second, by the normal processes of weathering.

The vapors now escaping through fissures over large areas within the crater of Kilauea at times contain as high as 4.92 per cent of sulphuric acid, and ranging in temperature from the lowest to the last point of condensation. In many instances the walls of the fissures, through which the acid-laden steam escapes, are luminous with heat at night. Marked chemical changes in the rocks are in process about these solfataras, and similar alterations have been observed at a distance from recent volcanic activity, where “poison soils” prevent the growth of vegetation.

The sulphurous vapors, acting on the heated basalt, disintegrates it, changing the lime into gypsum, the aluminum and alkalis into alum, and the iron into the ferrous sulphate. These products separate out in distinct masses, and impart to the soil various colors and properties. The iron, upon exposure to the air, changes to the hydrous ferric oxide, and gives rise to laterites.

Geologically, the soils are classified into three types:

1. *Dark Red Soils*: Those derived from normal basalt by simple weathering in a hot, dry climate,—the red color being imparted by the anhydrous ferric oxide. They are the most fertile soils.

2. *Yellow and Light Red Soils*: Those derived from lavas, which were first altered by the action of sulphurous vapors, and subjected to subsequent weathering in a humid climate. The color is due to the hydrated ferric oxide. As a type they are generally lacking in fertility.

3. *Sedimentary Soils*: Those produced by disintegration of lava at high elevations, and then subsequently removed by rain-wash and streams to lower and flatter lands.

When compared with the glacial soils of America, the soils of the

¹ Maxwell, Walter. *Lavas and Soils of the Hawaiian Islands*. Investigations of the Hawaiian Experiment Station and Laboratories [Established by the Hawaiian Sugar Planters Association], pp. 1-186, map and four plates. Honolulu, 1898.

Hawaiian Islands show some remarkable peculiarities. They are of recent origin, are strongly basic in character, being composed largely of silicates soluble in acids. The leaching processes, to which they have been subjected, has removed in great measure the acidic constituents. The glacial soils of America, on the other hand, are derived from ancient rocks, and are composed largely of silicates insoluble in acids. The basic constituents have been largely removed by prolonged weathering, and the soils differ markedly from the rocks from which they were derived.

The soils of the Hawaiian Islands are classified by Maxwell, according to the climatic conditions under which they originated, as follows :

1. *Upland Soils*: Those formed under low temperatures and large rainfall.
2. *Lowland Soils*: Those formed under high temperature and small rainfall.

From analysis made on a large number of samples of these soils, it appears that those of the first class contain a large per cent of organic matter and nitrogen, while the elements of plant food have been largely removed by leaching ; and that the soils of the second class have a low content of organic matter and nitrogen, and a high percentage of plant-food elements in an available state. These differences are due to the fact that the lowland soils receive the surface waters from the upland soils.

In determining the availability of the food supply of the soils, the author assumed that the amount removed by cropping added to the amount carried away by drainage waters equaled the total available supply. From a large number of analyses made of the waters and of agricultural products, it was found that the amount of the various elements carried away from the soil by the drainage waters equaled the amount of similar elements removed by cropping. By a series of experiments to ascertain the action of organic acids of various degrees of concentration on the different soil constituents, it was found that aspartic acid dissolved the essential plant-food materials in approximately the same proportions as they were found in the drainage waters. Furthermore, it was found that a one-per-cent solution of this acid removed the same amounts of these materials in twenty-four hours as ten crops of sugar cane ; hence it was concluded that one-tenth of the amount of lime, phosphoric acid, and potash removed from a soil by a one-per-cent solution of aspartic acid in twenty-four hours is the available supply of that particular soil.

A special feature of this highly instructive report is the large number of analyses of rocks, soils, and water which it contains. It is unfortunate, however, that a more definite discrimination is not made between observed facts and hypotheses. An analytical table of contents and an index, both of which are absent, would have greatly enhanced the value of the report.